

# Hyundai Steel's Challenge toward “Automotive Steel Specialized Steelworks”



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| **Hyundai Steel Overview**

| **History of Challenge**

| **Toward “Automotive steel specialized steelworks”**

| **Vision Forward**

# Hyundai Steel at a Glance – Hyundai Motor Group



## 6 Business Groups

- Automobile
- **Steel**
- Construction
- Parts (Machinery)
- Logistics
- Finance

## Volume

- Sales of USD 270billion
- 50 Affiliates
- 150,000 Employees

## Applications

- Automotive
- Building
- Shipbuilding
- Onshore Energy
- Offshore Energy
- Wind Power
- Pipeline

# History of Growth

**1953**

Established as  
Korean Heavy  
Industry Corporation

**1978**

Incorporated into  
Hyundai Group

**Foundation  
&  
Expansion**

**2001**

Incorporated into  
Hyundai Motor  
Group

**Growth as  
a Comprehensive  
Steelmaker**

**2006**

Renamed to Hyundai  
Steel Company

Ground Breaking  
Ceremony for  
integrated steelworks

**2005**

Foundation  
of R&D center

**2004**

Ceremony marking the  
acquisition and merger of  
Hanbo steel's Dangjin  
plant

**2010**

Operation of blast  
furnace # 1 & 2

**2013**

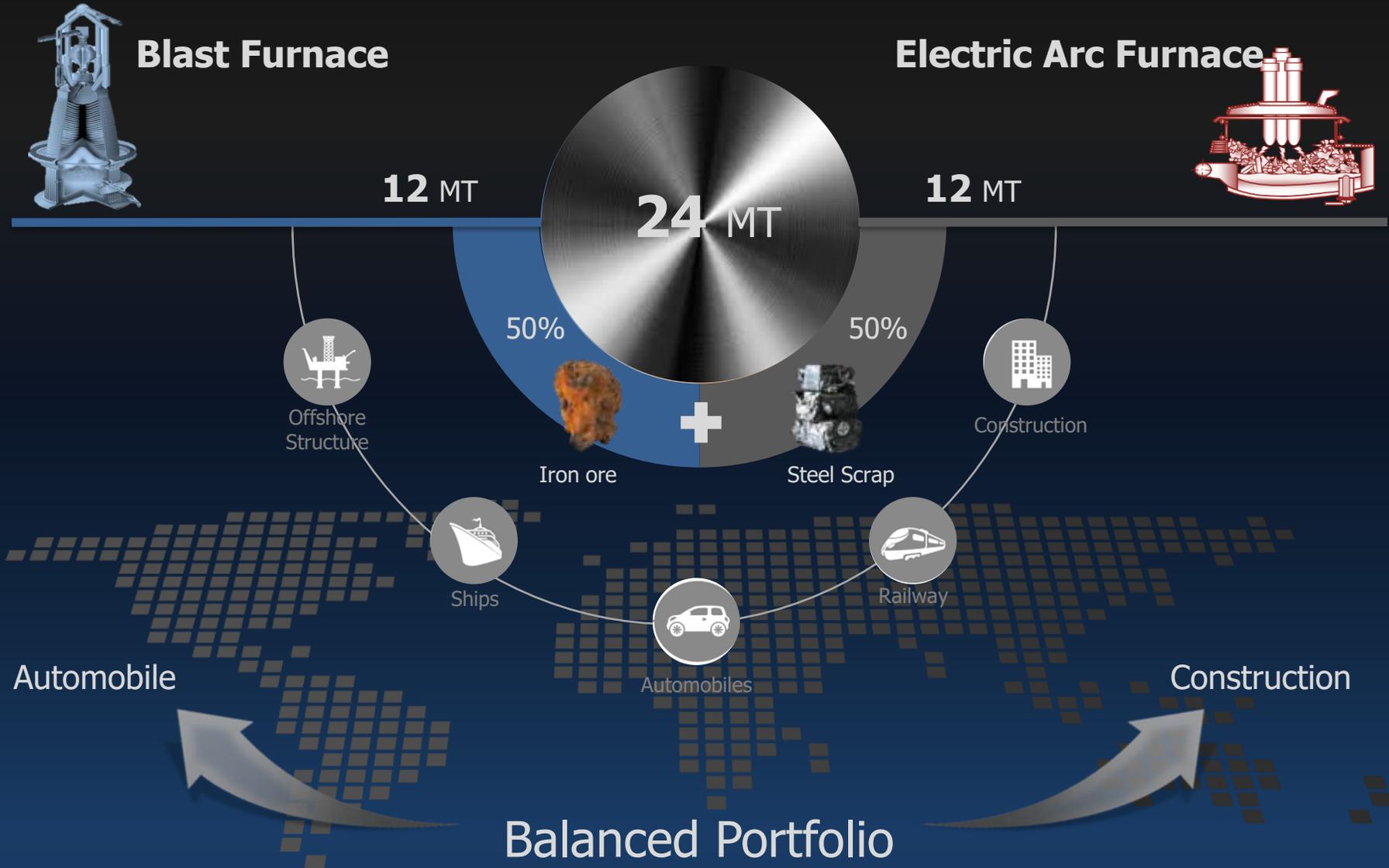
Operation of  
blast furnace # 3

**2014**

Merged with  
Hyundai Hysco

**To become  
a Global  
Steelmaker**

# Business Structure



# Domestic Production Sites

**Incheon(4.7 mil. ton)**  
**EAFs**  
 H-beams, stainless steel

**Dangjin(15.6 mil. ton)**  
**BFs, EAFs**  
 Hot/Cold-rolled coils, Heavy plates, Rebar

**Yesan**  
 Hot Stamping

**Suncheon**  
 Forging(0.3 mil. ton)

**Suncheon**  
 Cold rolled(2.0mil. ton)

**Pohang (3.4 mil. ton)**  
**EAFs**  
 H-beams, rebar, rails



From Blast Furnace	from Electric Arc Furnace
Hot Rolled Steel 	Rolled Shape 
Cold Rolled Steel 	Steel Reinforcement 
Heavy Plate 	Special Steel 

**Ulsan(1.2 mil. ton)**  
 Pipes

# Global Operations

- Manufacturing plant
- Steel Service Center



\* Sales Branch excluded

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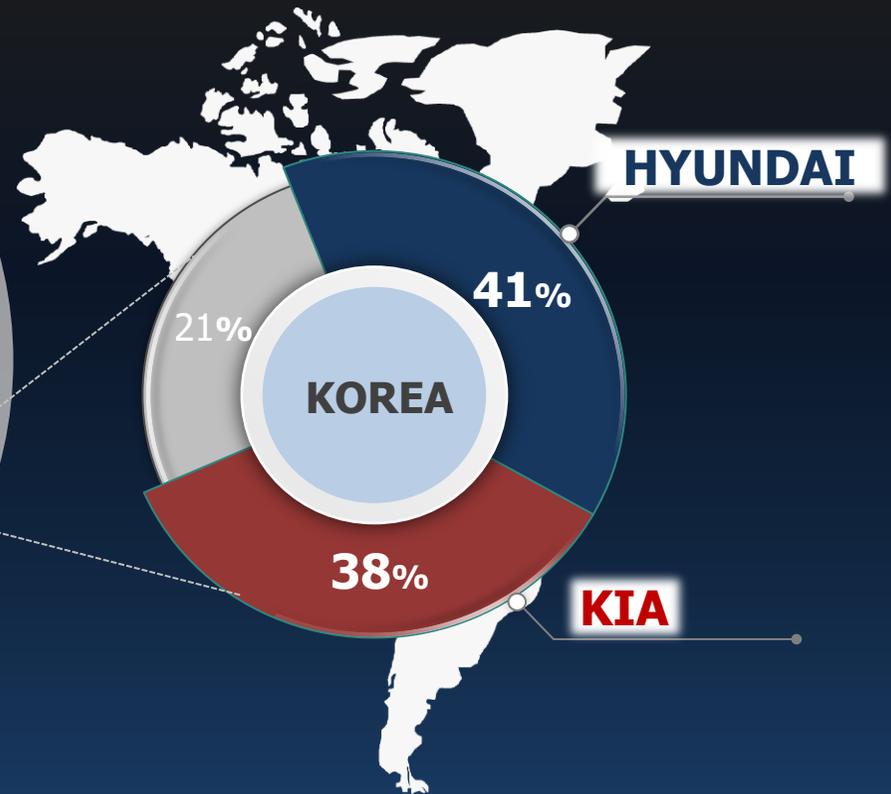
| Vision Forward

# Status of Korean Automotive Industry

## Domestic Production of each Country (million Unit)



## Global Production of HKMC : 820million unit



# Steel Industry and National Economy

## Steel Industry



Steel industry contribute to the economic growth of our country by stable supply of high-quality materials to downstream industries such as automotive, shipbuilding, construction

## Support for National Industry

Supplying competitive materials for Automotive, Shipbuilding, Construction Industry, etc.

1,082kg

Steel consumption per capita

## Capital Investment

Steel Industry needs huge capital investment

12.5%

Steel/  
manufacturing

## Employment Effect

Employment volume : about 100 thousand people

2.7%

Steel/  
manufacturing

# Steel supports Automotive Industry in Technological Side

[ Progress in Steel Performance ]

**Light Weight**

**Formability**

**Fuel Efficiency**

**Flexibility in Design**

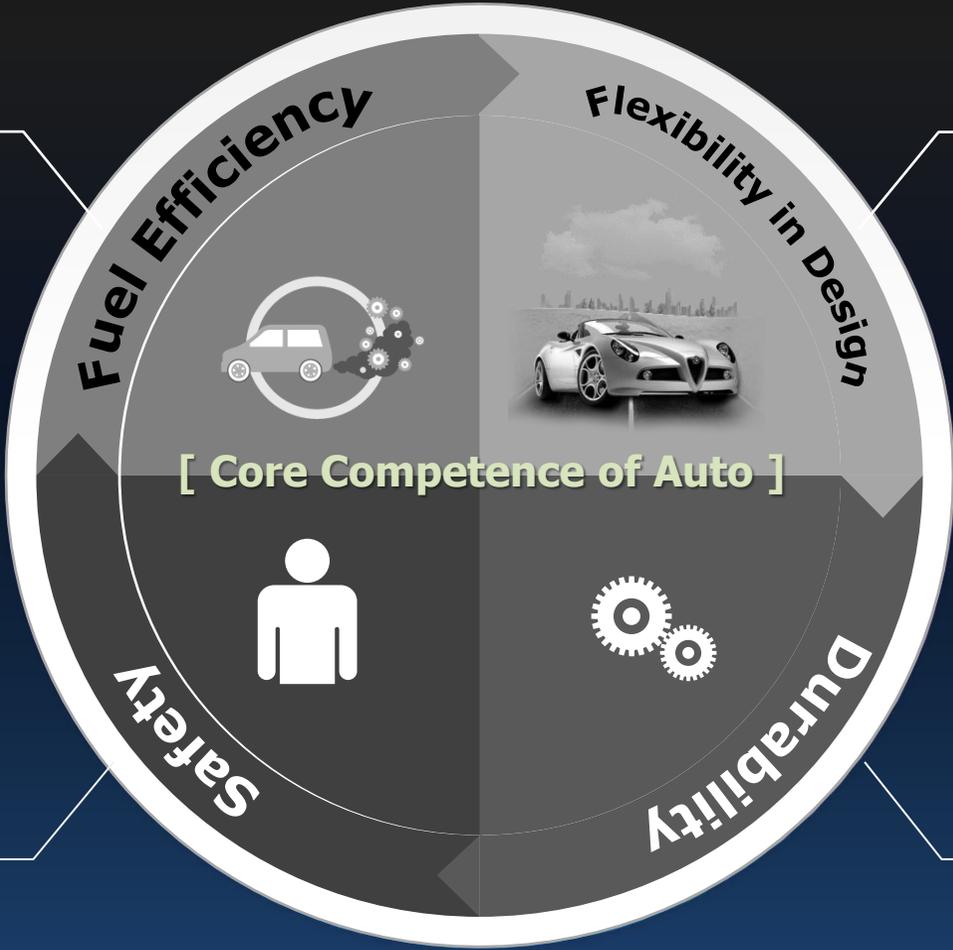
[ Core Competence of Auto ]

**Safety**

**Durability**

**Corrosion Resistance**

**High Strength**



# Automotive Steel, Key Competency of Steel Makers

Market Share of Global Top 7  
in automotive steel

65%

Automotive steel is technology-intensive, so there are a few players.



\* Production Capacity Portion

Average Operating Profit  
of Asian Steel maker

12%

Automotive steel is very profitable business, so the key players focus on it.



\* Automotive steel portion of steel makers' total shipment

# Launching of Integrated Steel Mill Project

*Near to major customers*

*Located mid-western part of Korea*



**Kia (Hwaseong)**  
Capacity 600,000 Units



**Hyundai Steel**  
(Dangjin)

**West Coast Express Way**



**Hyundai (Asan)**  
Capacity 300,000 Units

# Completion of the Project

[Before 2006]



**October 27, 2006**

Dangjin integrated steel mill  
project  
ground-breaking ceremony

[After 2013]



**Sites Areas : 8.82 million m<sup>2</sup> (2,179 acres)**

**Capacity : 12 million tons (3 Blast Furnacés)**



**Blast Furnace Blow-in**

- # 1 : January 2010
- # 2 : November 2010
- # 3 : September 2013

# Economic Effects of the Project

**Job Creation**

**201**

thousand people

**Investment**

**18.2**

billion US\$

**Value Added Inducement**

**9.34**

billion US\$

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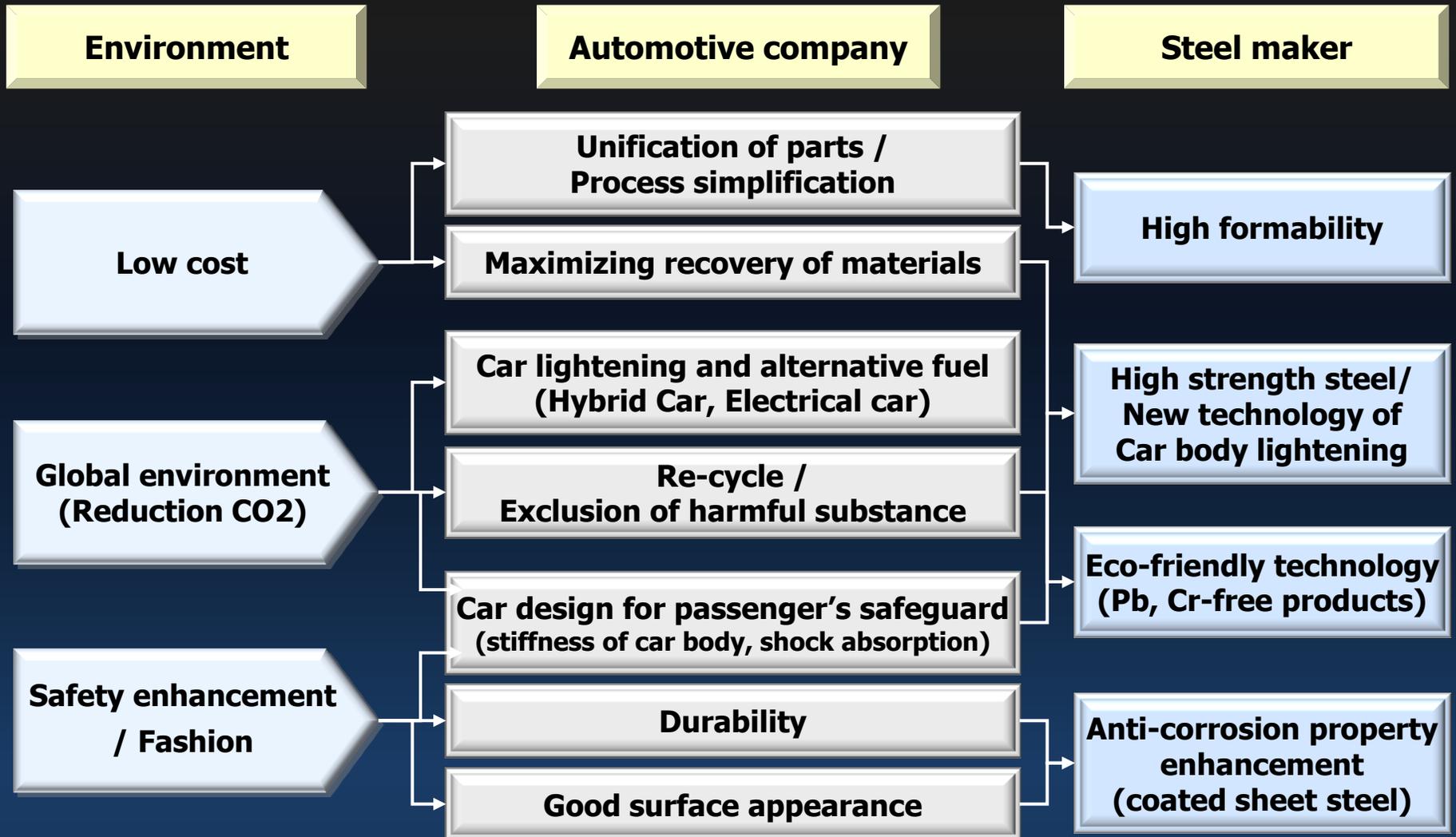
| **Toward “Automotive steel specialized steelworks”**

- Trend of Automotive steel
- Development of automotive steel
- Light-weight technologies (for part manufacturing)
- Application technologies

| Vision Forward

# Trends of Automotive steel

## Needs of automotive market and counter measurement of steel maker



# Automotive Steel : High Strengthening & Diversification

1993

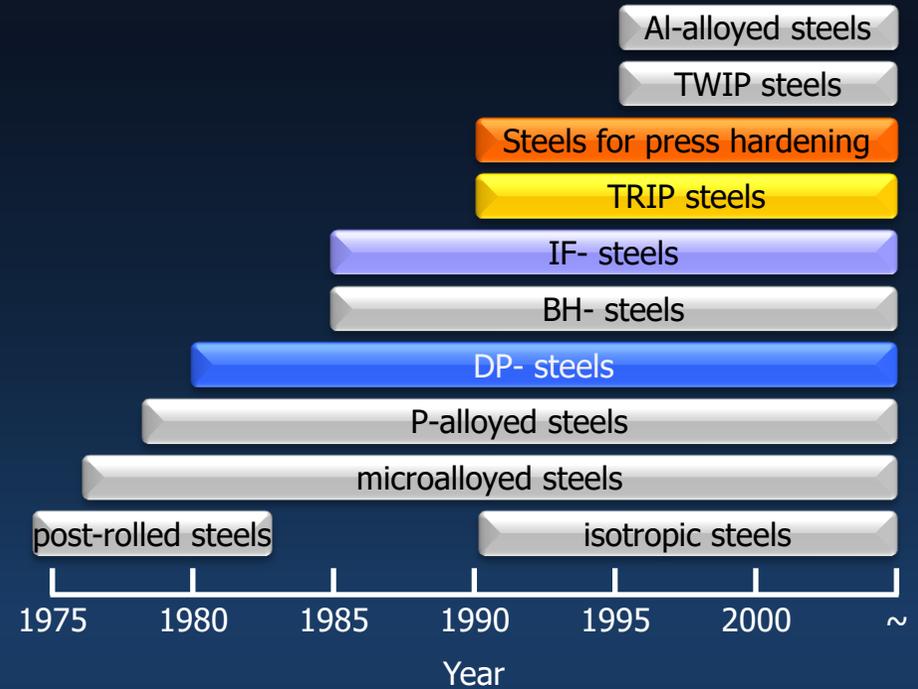
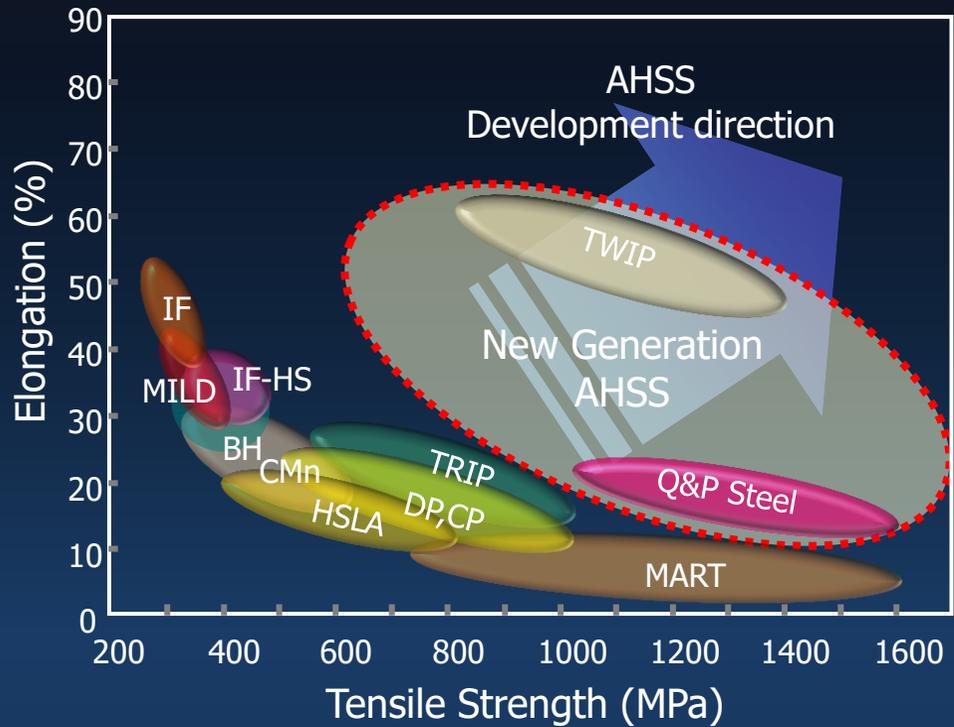
6 Steel Grade

2004

37 Steel Grade

2010~

Over 100 Steel Grade

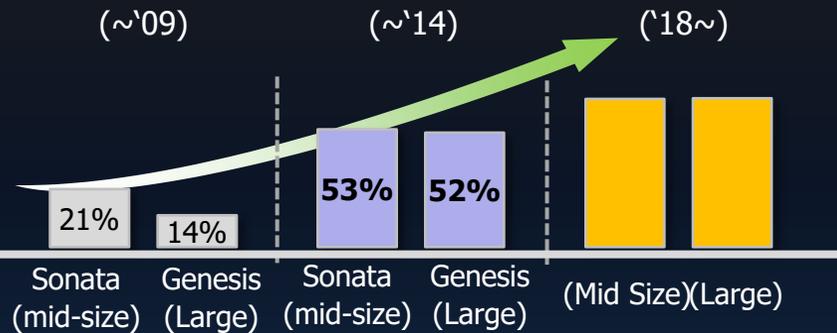


# Application Trend of Car-body Material

## Mass Production Car : High Strength Steel

### Portion of High Strength Steel

#### ● HKMC



#### ● Others

Portion of TS 60K↑ steel	Audi A3	Honda Civic	BMW 3series	Ford Fusion	VW Golf 7G
	35.3 %	49 %	16.0 %	30.9 %	37.0 %

### Adoption of Hot-stamping increases

- VW Golf 7G : 5% → 21%
- HKMC Sonata : 3% → 12%

## Luxury Car : Light-weight material

### Aluminum sheet



Tesla Model S ('12)

- ▶ **Best selling Luxury Sedan In US** (2013 , US\$70,000, 22.000units)
- ▶ **Max. driving range : 480km** (usual EV 120km)



Ford F150 ('15)

- ▶ **Al body** (317kg↓)
- ▶ **Best selling Pick-up in North America** (700,000~800,000 units/year)

### CFRP (Carbon Fiber Reinforced Plastics)



BMW i3 ('13)

- ▶ **First mass produced car with CFRP**

- ▶ **CFRP portion 23%**



BMW i8 ('14)

- ▶ **Driving range/Max. Speed /0-100 times** : 130km/150kph/7.2s

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# Development of Automotive Steel in Hyundai Steel

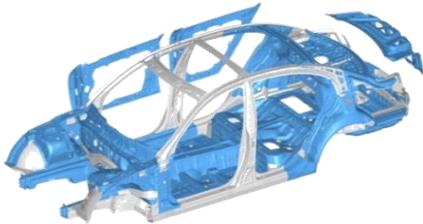
## Developed 99.6% of Automotive Steel used by HKMC

2010

49 grades

Inner Panel

High Formability  
60K



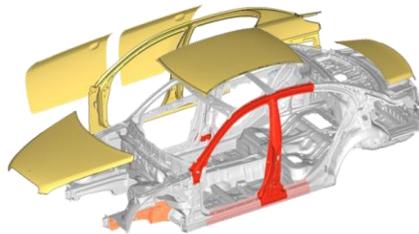
Floor

2011

22 grades

Outer Panel

80K high strength  
150K hot stamping



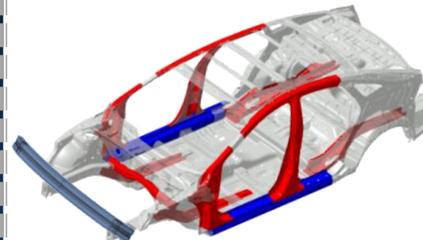
Door/Hood

2012~14

17 grades

Ultra High  
Strength Steel

100/120k

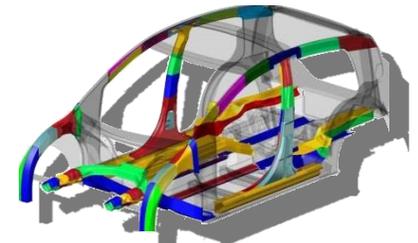


Center Pillar

2015~

Newly developed  
grades

Next-generation  
Automotive steel



Light Weight/Anti-corrosive

# Manufacturing Process & Product Mix (Integrated Steel Mill)

Unit : thousand tons

## Iron Making

Iron ore  
19,000



Cokes  
8,700



Others  
3,600



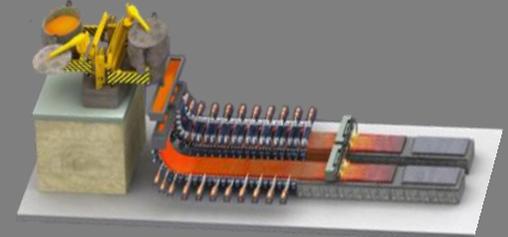
Molten Iron  
12,000

## Steel Making



Molten Steel  
12,800

## Continuous casting



Slab  
12,500

## Product

Hot Rolled Coil



8,850

Cold Rolled Coil



6,030

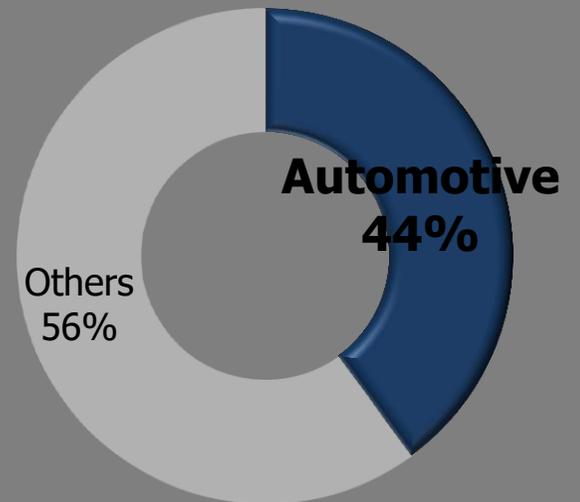
Heavy plate



2,500

**Total Products**  
**11,180**

## Product Mix



# R&D Process for Automotive Steel

## Vacuum melting



- vacuum melting according to alloy design

## Hot rolling



- hot rolling of reheated Ingot
- main factor : reheating temp. coiling temp

## Cold Rolling



- cold rolling of Hot coil to get target thickness
- main factor : rolling force

## Analysis

Composition	OES, C/S, N/O
Formability	LDR, LDH, FLD
Coating layer/ Surface	AES, XRF Roughness measurement
Microstructure	XRD, EBSD, TEM, Dilatometer

## Coating



- simulation of coating
- main factor : atmosphere, temp.

## Continuous Annealing



- Annealing of F/H
- main factor : annealing temp, cooling rate

# Hyundai Steel : Directions for Automotive steel

## Outer panel



**High Strength**  
(Door)

340MPa  
BH

Dent  
resistance

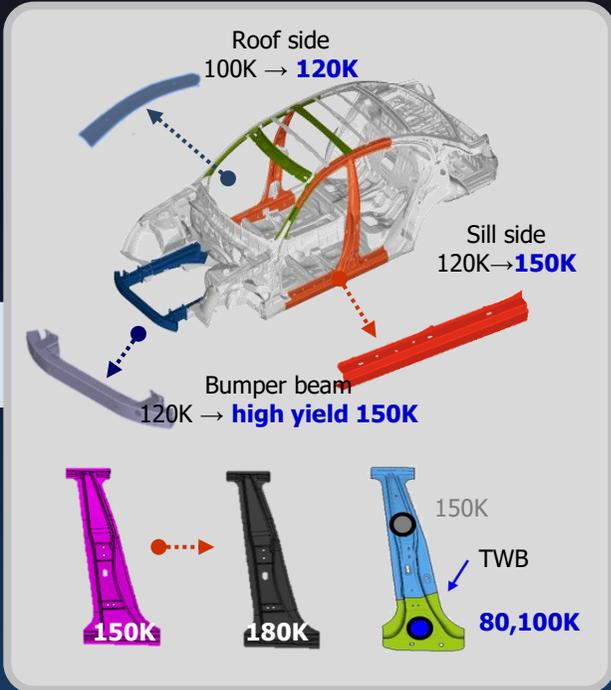
490DP Outer

**High Strength**  
(side Outer)

Mild

High Strength  
Outer

## Frame structure



**High Strength**

340~440MPa

+

**High formability**

(ultra high strength  
CRC)

980MPa

Car-body  
lightening  
Safety  
performance

780MPa AMP

1180MPa

1180MPa

1470MPa

**High Strength**

+

**High formability**

(Heat treatment)

1470MPa  
Hot stamping

Light weight  
Safety (Crash)

1.8 (2.0) GPa  
Hot stamping

TWB +  
Hot stamping

## Chassis



**High Strength +  
burring**

540/590MPa  
PO

Anti  
corrosive

540/590/780MPa  
Coated HRC

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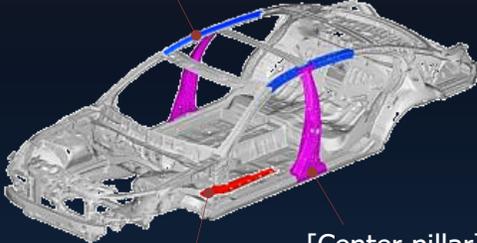
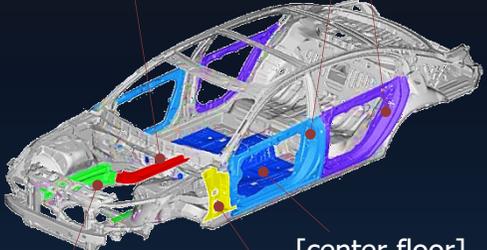
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# New technology for Parts – Application & Manufacturing line

	Hot Stamping	Hydro Forming	Tailor Welded Blanks
Parts	 <p>[Roof side rail]</p> <p>[Center pillar]</p> <p>[Center floor upper bumper]</p>	 <p>[Front sub frame]</p> <p>[rear axle frame]</p> <p>[trailing arm]</p> <p>[frame side member]</p>	 <p>[front/rear door inner]</p> <p>[front side rear member]</p> <p>[center floor]</p> <p>[front pillar inner]</p> <p>[front side member]</p>
Capa.	<p><b>17 Line</b> (Ulsan 2, Yesan 10, Overseas 5)</p> <p><b>38million unit/year</b></p>	<p><b>3 Line</b> (Ulsan 3)</p> <p><b>2.1million unit/year</b></p>	<p><b>23 Line</b> (Suncheon 6, Ulsan 4, Yesan 2, Overseas 11)</p> <p><b>25million unit/year</b></p>

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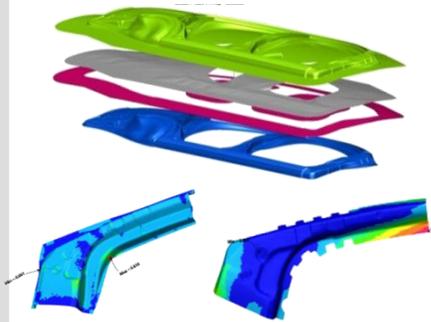
# Application Engineering : Concept and Scope



Convergence  
Of  
Technology



Forming / simulation



Welding



Anti-corrosion



Collaboration



# EVI (Early Vendor Involvement)

## Customer & Social Needs

Safety, Convenience, Cost  
Eco-Friendly, Recycling



## New Carbody



## EVI Activities

Provide steel based total solution for light weight car body

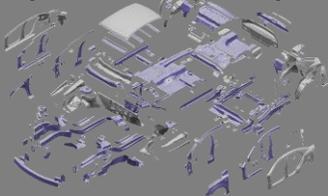
## Optimized autobody



Weight vs Cost vs Performance

## Proposal of Optimum solution

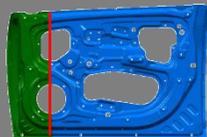
(material, Process)



< Optimum Material proposal >



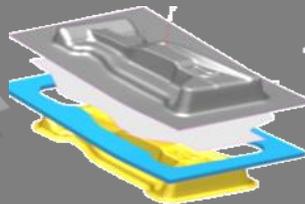
Hot Stamping



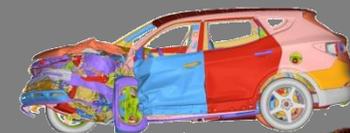
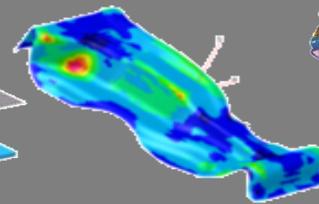
TWB

< Light-weight technology >

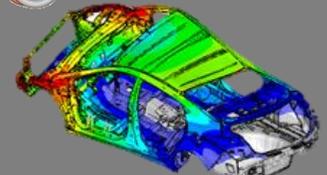
## CAE Analysis (Design & Structure)



< Stamping analysis >



< Crash and stiffness analysis >



# Status of HSC's Application Engineering



	Main Building	Rolling Lab	Ironmaking Lab	Total solution Center
Role	<ul style="list-style-type: none"> <li>○ Analysis</li> <li>○ KOLAS</li> </ul>	<ul style="list-style-type: none"> <li>○ Development New grades</li> <li>○ Car teardown</li> </ul>	<ul style="list-style-type: none"> <li>○ Simulation of iron making</li> <li>○ Raw mat'l quality control</li> </ul>	<ul style="list-style-type: none"> <li>○ Application Engineering</li> <li>○ Environment tech.</li> </ul>
Equipment	<ul style="list-style-type: none"> <li>○ TEM, SEM...</li> </ul> 	<ul style="list-style-type: none"> <li>○ HR/CR simulator</li> </ul> 	<ul style="list-style-type: none"> <li>○ Cokes oven simulator</li> </ul> 	<ul style="list-style-type: none"> <li>○ 1,000t Servo Press</li> </ul> 

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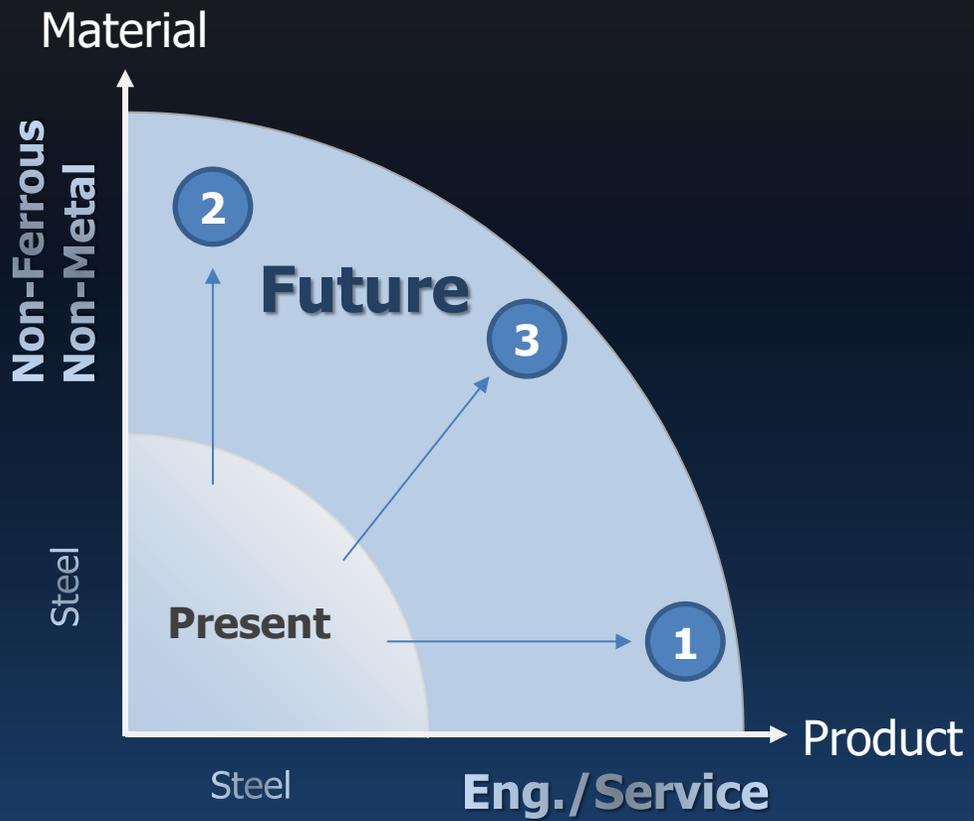
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# What is next in HSC's Automotive steel

New Vision : "Engineering Future beyond Steel"  
 Providing new Value beyond Steel



**Up to now : Fast Follower**

Develop all of the automotive steel (88 grades)

Body (ULC steel)      Frame (AHSS)

**From now on : First Mover**

<b>Next generation Steel</b>	<b>Convergence of Technology</b>	<b>Total sol'n</b>
High Strength + High formability	<b>Automotive steel leader</b>	Application Eng Material Tech. (non ferrous , non metal)